Original Research Article

Relation between body mass index, forced expiratory volume in one second and 6 minute walk test in stable COPD patients

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a common respiratory disorder characterized by irreversible, progressive airflow obstruction. It is diagnosed by spirometry which measures FEV1 and bronchoreversibility. Recent focus has been on COPD systemic effects like malnutrition, cardiovascular disorders, diabetes, musculoskeletal disorders, anxiety and depression. A composite index named BODE index (BMI, FEV1, dyspnea, 6MWT) has a better prediction of mortality than FEV1 alone in these patients. Relation between components of BODE like BMI, FEV1 and 6MWT has been an area of interest since it measures nutritional status (BMI), airway obstruction (FEV1) and exercise capacity (6MWT). We tried to evaluate the relation between lower BMI (<21) and higher BMI groups (>21) with respect to FEV1 and 6MWT.
Methods: A cross sectional observation study was conducted in a tertiary care centre. Stable patients of COPD were recruited from to outpatient department of respiratory medicine. BMI, FEV1 and 6MWT were calculated. Patients are made into 2 groups with BMI less than 21 and more than 21. Both FEV1 and 6MWT means were calculated and analyzed to find out any difference between these two groups.
Results: There was no statistical difference of FEV1 and 6MWT between lower and higher BMI groups.
Conclusions: In COPD patients, FEV1 and 6MWT values were not statistically different between lower and higher BMI groups. Further studies are needed to prove that other anthropometric measurement like fat free mass index can be a better substitute for more accurate assessment of exercise capacity.

Keywords: Body mass index, COPD, FEV1, 6 Minute walk test

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common respiratory condition affecting world-wide population. Smoking in various forms like tobacco smoking both active and passive, biomass fuel exposure, occupational exposures, low birth weight and recurrent child hood infections are the etiological factors. As per WHO estimates in 2005, 5.4 million deaths were caused by tobacco smoke and the projected deaths by 2030 will be 8.3 million deaths. Household air pollution also contributes to disease significantly in developing countries. Nearly 3 billion people are exposed to household air pollution and 4 million deaths annually are attributed to this.[1] Infections like tuberculosis may contribute significantly to this pool.[2] COPD is projected to be 3rd leading cause of death by 2030.[3] More alarming feature is 90% of COPD related deaths in low and middle income countries and almost equal incidence of disease in males and females. More than 29 million disability adjusted life years (DALYs) per annum are lost due to COPD, according to World Bank estimates. COPD is grossly under recognised disease even in well developed countries. Only 16-46% cases of projected number according to smoking prevalence are diagnosed.[4] Diagnosis of COPD is mainly by clinical and spirometry.[5]

Demonstration of obstruction by FEV1/FVC (forced expiratory volume in one second/forced vital capacity) ratio less than 0.7 with poor bronchoreversibilty is the mainstay of diagnosis. However spirometry has several disadvantages like its poor correlation with systemic features, breathlessness scales and health status.

Effects of are not confined to respiratory system, rather they are systemic. These are manifested in the form of weight loss, cachexia, cardiovascular diseases, diabetes, musculoskeletal disorders and depression etc.

So it became necessity to study the effects of COPD in a comprehensive manner than limiting to respiratory manifestations. Of these the most important aspect is nutritional status, which is measured by BMI (body mass index). The relation of this parameter is discussed with other indicators like 6 MWT (6 minute walk test) which measures exercise capacity and pulmonary function parameter, FEV1. The aim of the study was to find out relation between BMI and FEV1 and 6 MWT test in stable COPD patients.

METHODS

This is a cross sectional observation study conducted in a tertiary care centre attending to respiratory medicine outpatient department. 120 patients who were diagnosed as stable COPD were included. Patients who are hemodynamically unstable due to any cause, patients who were unable to do spirometry, contraindicated for 6 MWT test were excluded. Spirometry was done with Koko PFT system and software®. MMRC scale was used for breathlessness severity. 6 minute walk test was used according to ATS guidelines.

Stastistical analysis

Means of BMI, FEV1 and 6MWT were calculated. Patients with BMI of less than 21 and more than 21 were made into 2 groups. Analysis was done to find out relation between 2 groups of BMI and FEV1, 6MWT.

RESULTS

Total number of patients was 120. Mean age was 60.13±7.90 years (range 40-80), 86.70% males (n = 104) and 13.3% females (n = 16). There were 100 smokers (83%). Of them 32 were ex-smokers and remaining were active smokers. 20 (17%) were nonsmokers. Mean of FEV1±SE (L) in low BMI group (n = 23) was 54.6±3.59 and high BMI group (n=97) was 61±1.53. P - value was 0.07 by 2 sample t-test. There was no significant correlation in FEV1 between these BMI groups.

Table 1: 2 sample t-test showing relation between variable FEV1 and BMI less than and more than 21 groups.

Type	Mean FEV1(L)	Std dev	Std err	Minimum	Maximum	
1	54.6087	17.2172	3.5900	25.0000	88.0000	
2	61.0000	15.1079	1.5340	26.0000	92.0000	
Diff (1-2)	-6.3913	15.5229	3.6001			
Type	Mean FEV1(L)	95% CL mean		Std dev	95% CL std dev	
1	54.6087	47.1634	62.0540	17.2172	13.3157	24.3683
2	61.0000	57.9551	64.0449	15.1079	13.2399	17.5945
Diff (1-2)	-6.3913	-13.5205	0.7379	15.5229	13.7699	17.7915
Diff (1-2)	-6.3913	-14.3585	1.5759			

Group 1: BMI less than 21; Group 2:BMI more than 21; Std dev : Standard deviation; Std Err: Standard error.

Table 2: 2 sample t-test of variable 6MWT and groups BMI less than 21 and more than 21.

Type	Mean 6MWT (m)	Std dev	Std err	Minimum	Maximum	
1	292.7	77.8356	16.2298	136.0	482.0	
2	315.0	69.6523	7.0721	132.0	543.0	
Diff (1-2)	-22.2918	71.2493	16.5242			
Type	Mean 6MWT(M)	95% CL mean		Std dev	95% CL std dev	
1	292.7	259.1	326.4	77.8356	60.1977	110.2
2	315.0	301.0	329.1	69.6523	61.0402	81.1161
Diff (1-2)	-22.2918	-55.0143	10.4307	71.2493	63.2031	81.6617
Diff (1-2)	-22.2918	-58.4039	13.8203			

Group 1: BMI less than 21; Group 2:BMI more than 21; Std Dev : Standard deviation; Std err: Standard error

Mean of 6 MWT±SE in low BMI group (n = 23) was 292.7±16.22 m and high BMI group (n = 97) was 315±7.07 m.p value was 0.17 by using 2 sample t-test, indicating there was no difference in 6 MWT between low BMI and high BMI groups. According to GOLD staging, moderate severe COPD patients were 57.50%

(n = 69) of all, severe COPD were 27.50% (n = 33), mild COPD were 11.64% (n = 14) and very severe were 3.3% (n = 4).

DISCUSSION

COPD is a progressive irreversible airway obstructive disease with significant systemic effects.[6] It is considered as a systemic disease in view of its association with multiple comorbidities and common pathophysiological features. Cardiovascular diseases are the most frequent followed by diabetes, depression and cancers, anxiety and depression.[7,8] Loss of oxidative type of muscle fibre, atrophy, and increased protein turnover are mechanisms explained for sarcopenia.[9] In a study done by Van Manen comorbidities were present in more than 50% of patients.[10] An interesting finding was only hypertension and history of tuberculosis was positively associated with COPD among 15 comorbidities.[11]

Nutritional aspects are important in COPD and they are manifested by weight loss and cachexia. Body composition and nutritional aspect can be expressed in various parameters like body mass index (BMI), lean body mass (LBM), fat free mass index (FFMI), fat mass, skeletal muscle mass index (SMI). Sarcopenia is a significant problem which can lead to compromise in functional status, activity restriction thereby leading to depression and other psychological issues. In one study, prevalence of malnutrition in COPD patients was 22%.[12] In an Indian study 38% of patients were underweight.[13] Several biomarkers were evaluated to explain association between systemic effects and COPD. Fibrinogen was shown to have disease significant impact on the disease course.[14]

Pathogenesis in COPD is multifaceted. It includes inflammation caused by smoking and environmental agents ,protease and anti-protease imbalance, oxidative stress.[15] Reactive oxygen species have a role in activating transcriptional factors leading to proinflammatory gene expression thereby enhancing normal inflammation.[16] New mechanisms like autoimmunity, increased apoptosis of alveolar epithelial cells, accelerated aging are also proposed.[17-19] The end result of this process in lung is loss of alveolar attachments, progressive obstruction of airways leading to dynamic hyperinflation of lungs, increased work of breathing, and hypoxia due to loss of parenchyma, pulmonary hypertension, corpulmonale and right heart failure.

With these both systemic and pulmonary effects, the concept of COPD as a systemic disease has gained importance and comprehensive management including nutritional replacement, concomitant comorbidity treatments, pulmonary rehabilitation, and prevention of infections with vaccinations along with pulmonary pharmacotherapy are getting attention. COPD is diagnosed by background clinical features and spirometry. FEV1 alone may not be an ideal parameter to explain all the disease effects. In a study of long term follow-up of lung function, decline of FEV1 was not uniform and stage II and III patients had significant fall in FEV1.[20] Longitudinal changes in dyspnea were dependent not only on FEV1 but also worsening diffusion capacity and psychological status.[21] All these data along with systemic effects are reflected in newer GOLD definition and staging.[5]

BODE index, a composite index for predicting mortality in COPD patients has proved to be a better one than FEV1. BODE index consists body mass index (BMI) calculated by body weight in kilograms divided by the square of height in meters, obstruction (O) by FEV1, dysnea (D) by MMRC scale (modified medical research council scale) and exercise capacity (E) by 6 minute walk test. Its a better index than FEV1 because of its inclusion of parameters of systemic effects of COPD like dyspnea score (MMRC), exercise capacity (6MWT).[22] BODE index can predict readmissions along with other outcomes, frequency of exacerbations.[23,24] Progression of COPD is very heterogenous and many patients did not show significant FEV1 decline or BODE progression indicates that even needs more dimensions to be added for evaluation.[25] For prediction of exacerbation DOSE index (dyspnea, obstruction, smoking, exercise capacity) was better than BODE index.[26]

Extensive literature is available regarding BMI in COPD. Advantage with BMI is it's a simple anthropometric measurement that can be used anywhere. Prevalence of COPD was more in lesser BMI patients and it's prevalence did not differ in countries.[27] Low BMI was shown to increase the risk of developing COPD, and increased mortality.[28-31] In another study low BMI was shown as both consequence and predisposing factor for COPD.[32] Higher BMI was also associated with lesser mortality leading to the concept of obesity paradox.[31] Several comparative studies have shown FFMI (fat free mass index) as better index than BMI as the former better reflects the skeletal muscle status and mortality predictor in COPD.[33] Skin fold anthropometry was proven to be an accurate method of FFMI in COPD.[34]

In our study we did not get a significant relation between BMI and FEV1 as reflected by other studies.[12] One more study also has shown similar results i.e. FFMI has better prediction capacity for FEV1 than BMI.[35] We assume low FFMI, which was not calculated in our study, might be the reason for the negative association. This needs further attention and it's necessary to develop simple clinical methods which can measure FFMI accurately and can replace BMI.

6 minute walk test is a simple way of assessing exercise tolerance in COPD patients. It's a well evaluated ,reproducible test used not only for COPD, for other chronic diseases also.[36] It has several applications like assessing functional status, monitoring patients undergoing pulmonary rehabilitation, evaluate exercise

desaturation.[37] In ECLIPSE study poor determinants of 6 MWT were severe airflow obstruction, moderate to severe dyspnea, emphysema changes in CT, oxygen requirement during test and depressive symptoms.[38] In another study by Ischaki et al significant correlation was observed between FFMI and 6MWT and it was a better indicator than BMI.[39] 6MWT has not shown good correlation with BMI by multiple regression analysis in another study.[40]

In present study the negative association was thought to be due to confounding factors and unequal distribution of number of patients.

Limitations of the study were, that study didn't have equal number of patients in all severities of COPD, more groups of BMI and lesser number of female patients. We look forward to have studies which can assess relation between different components in a wide spectrum of groups of severity and obesity.

CONCLUSION

In this study, FEV1 and 6MWT didn't differ in higher or lower BMI patients with COPD. BMI, FEV1 and 6MWT are different faces of COPD assessment and in this study we propose whether BMI can be replaced with other simple anthropometric measures like FFMI (fat free mass index). Further studies are needed to evaluate this aspect which may provide more accurate and comprehensive assessment of all aspects of COPD.

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